Screening of Initial Parton Production in Ultrarelativistic Heavy-ion Collisions *

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Because the dominant QCD parton cross sections are singular in the soft scattering limit, most model calculations of minijet production via perturbative QCD (pQCD) have introduced an infrared cut-off, p_0, corresponding to the smallest permissible transverse momentum transfer in a $2 \to 2$ parton scattering, to which perturbative QCD can still be applied. This cut-off is used in most of the models to separate perturbative hard processes from nonperturbative soft interactions. Since there is no distinct boundary between soft and hard physics, both the hard and soft part of the interaction in this scheme are very sensitive to the cut-off p_0.

Heavy ion collisions differ from pp collisions in that minijets are produced in large number, so that a medium of minijets is formed. In the space-time evolution of a heavy-ion collision soft particle production will be completed after semihard and hard processes. Therefore, the soft interactions are expected to be screened by interactions with the semihard quanta (minijets). We here take a step further by proposing that the perturbative semihard particle production should also be screened by the processes which have happened even earlier, i.e., by the harder processes.

We considered color screening of initial semihard parton production in a phenomenological but self-consistent manner. We first compute the static electric screening mass of the parton system by using the number distributions of produced minijets with transverse momentum larger than p_T and by taking into account the formation time of the minijets. We then use the obtained electric screening mass as a regulator in divergent t and u-channel sub-processes for the production of partons with transverse momentum smaller than p_T. We iteratively compute the lowest order minijet cross section with a feedback from the screening mass towards the region $p_T \sim \mu_D \lesssim 2$ GeV.

In Fig. 1 we show the screening mass μ_D and the screened one-jet cross section as functions of p_T. We can see that the medium of produced minijets regulates the rapid growth of the jet cross section. Finally, at $\mu_D \sim p_T$, the cross section saturates. For sufficiently large nuclei and for high collision energies this happens in the perturbative region $p_T \gg \Lambda_{QCD}$.

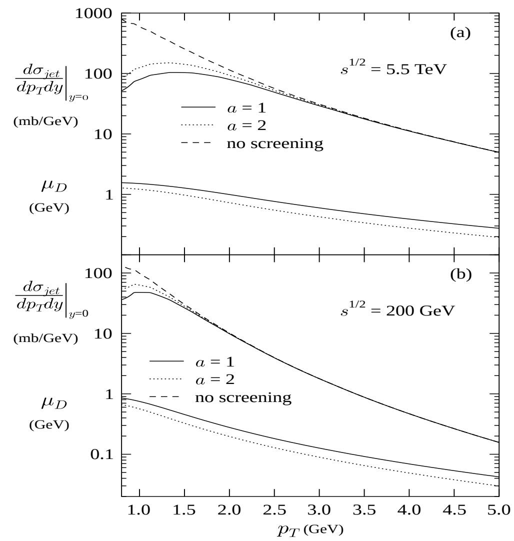

Fig. 2

Figure 1: (**a**) Differential minijet cross section $d\sigma_{\text{jet}}/dp_T dy$ at $y = 0$ and screening mass μ_D as functions of transverse momentum p_T in a pp sub-process of a central AA collision at $\sqrt{s} = 5.5\,A$TeV with $A = 200$. The dashed line is for the unscreened cross section, the solid and dotted curves for the screened case with different parameters a. Nuclear shadowing is not taken into account. (**b**) The same as in panel (a) but for $\sqrt{s} = 200\,A$GeV.

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